

Haruo OKUNO*: Electron-microscopical study
on antarctic diatoms (5)**

奥野 春 雄*: 南氷洋産珪藻の電子顯微鏡的研究 (5)**
(with Plates I-III)

Rhizosolenia hebetata (Bailey) Gran f. **semispina** (Hensen) Gran (Pl. I, fig. 1; Pl. II, figs. 1-1'), Hustedt in A. Schmidt, At. Diat., pl. 320, figs. 9-13 (1920); Heiden & Kolbe, Mar. Diat. Südpol.-Exped., pl. 8, fig. 158 (1928); Mills, Index Diat.: 1405 (1934); Cupp, Bull. Scrip. Inst. Ocean., 5, No. 1: 88, fig. 50-B (1943); Boden, Journ. Mar. Res., 8, No. 1: 8 (1949), & Trans. R. Soc. S. Afr., 32: 366, fig. 44 (1950); Cleve-Euler, Diat. Schw. u. Fin., 1: 90, fig. 170, c-e (1951).

L. M. S.⁽¹⁾ (Pl. II, fig. 1) Cells cylindrical. About 1.4 mm long, about 10-22 μ in diameter. Valves drawn out, at the end armed with a long, straight or slightly curved, hair-like spine. The spine at its base, somewhat swollen. Intercalary bands are arranged in two, dorsiventral rows.

E. M. S.⁽²⁾ (Pl. I, fig. 1; Pl. II, fig. 1') Fragments of valves and intercalary bands were observed by the direct preparation. Frustule pores both of the valve and the intercalary band are locular, and probably hexagonal. Loculi about 19-26 in 10 μ , and about 400-500 m μ in diameter, arranged in three lines decussating at about 60 degrees. Sieve membranes of the loculi are very thin, each of them with two, longitudinal, slit-like sieve pores, about 200-300 m μ long and about 64-80 m μ broad. The loculus is of the same type with *Rhiz. styliformis* var. *longispina* (Okuno, Journ. Jap. Bot., 27: 47, pl. I, figs. 1, 1'. 1952).

Sample: no. 1 (+); no. 3 (++) ; no. 8 (+); no. 9 (++) ; no. 15 (+); no. 16 (++) ; no. 20 (++) ; no. 22 (++) ; no. 25 (++) ; no. 29 (++) ; no. 31 (++) ; no. 34 (++) ; no. 40 (+); no. 43 (+); no. 52 (+++); no. 57 (+++); no. 60 (+); no. 65 (+++); no. 67 (+++); no. 76 (+); no. 86 (++) ; no. 91 (+); no. 99 (+); no. 100 (+); no. 111 (+); no. 116 (+); no. 117 (+).

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(1) L. M. S.: Light-microscopical structure.

(2) E. M. S.: Electron-microscopical structure.

In the Sample of the antarctic planktons (64° - 27° S.; 149° - 5° E., Dec. 29, 1949) collected by T. Kitamura of the Kobe Marine Meteorological Observatory, I found abundant cells of the present species.

Cocconeis costata Gregory (Pl. I, figs. 2a-c; Pl. II, figs. 3-3''), Cleve, Synop. Nav. Diat., 2: 182 (1895); Mills, Index Diat.: 414 (1933); Boden, Trans. R. Soc. S. Afr., 32: 410, fig. 91 (1950).

L. M. S. (Pl. II, fig. 3) Valves elliptical, 35-38 (12-40) μ long, 20-23 (8-23) μ broad. Pseudoraphe of the upper valve, narrow-linear. Costae slightly radiate, 5-6 in 10μ . Frustule pores between the costae about 14-15 in 10μ . The lower valve could not be found in my slides.

E. M. S. (Pl. I, figs. 2a-c; Pl. II, figs. 3'-3'') Frustule pores in the upper valve probably locular. Loculi subrectangular? The sieve membrane of the loculus netveined, usually with a somewhat broad, crossed part, from where sometimes, delicate secondary sieve membranes branch off. Sieve pores about 4 in a loculus, often divided into several secondary sieve pores of various shapes and sizes.

Sample: no. 4 (+); no. 9 (+); no. 15 (+); no. 40 (+); no. 43 (+); no. 65 (+); no. 95 (+); no. 100 (+); no. 111 (+).

Thalassiothrix longissima Cleve & Grunow (Pl. II, figs. 2a-2'), Heiden & Kolbe, Mar. Diat. Deut. Südpol.-Exped., pl. 6, fig. 123 (1928); Mills, Index Diat.: 1610 (1934); Cupp, Bull. Scrip. Inst. Ocean., 5: 184, fig. 134 (1943); Boden, Trans. R. S. Afr., 32: 408, fig. 89 (1950).

Syn. *Thal. longissima* var. *antarctica* Grunow, V. Heurck, Synop. Diat. Belg., pl. 37, fig. 10 (1880-1)—*Thal. antarctica* Karsten, Phytopl. Antarkt. Meer.: 124, pl. 17, figs. 12, 12a-c (1905).

L. M. S. (figs. 2a-b) Cells solitary, four-sided, more or less curved, about 3.6 (1-4) mm long. Valves narrow-linear, about 3-6 μ broad. Frustule pores transverse, marginal, about 8-11 (8-13) in 10μ . Spines at the corners of the valve are almost absent in the present specimens. At the ends of the valve, beset with 1-3 mucilage pores.

E. M. S. (fig. 2') According to my experiment, the complete frustule of this species, even removed of its cell contents, was impenetrable to the electron beam. Further, it was difficult to break the frustule into the suitable fragments for the electron microscopy. The present micrograph is not still enough to show detailed fine structure of the frustule pores, but at least, it

can show the existence of the sieve membranes perforated by roundish sieve pores.

Abundant: Sample: no. 4 (+++); no. 9 (+); no. 12 (++++); no. 15 (++++); no. 16 (++++); no. 20 (++++); no. 22 (+++); no. 31 (++++); no. 40 (++++); no. 43 (++++); no. 60 (+++); no. 65 (++) ; no. 80 (++) ; no. 91 (++) ; no. 107 (++) ; no. 116 (+); no. 117 (+++).

Chaetoceros criophilum Castracane (Pl. II, figs. 4'-4'')

In my previous paper (Journ. Jap. Bot., 27: 349, Pl. I. fig. 4'), I showed an electron micrograph of the spine of the present species. But, in that micrograph, because of the overthickness of the spine for the penetration of electron beam, the pores on the wall of the spine could not be revealed. In the present electron micrographs, which were obtained from the thin fragments of the spines, the pores are clearly shown. The wall of the spine is porous sectionally in one (or two?) longitudinal porous area. The pore is the 'hole⁽³⁾.' Holes roundish, about 100-150 m μ in diameter, about 5-6 in 1 μ , arranged in about 4-6 longitudinal rows.

Corethron Valdiviae Karsten (Pl. II. figs. 5'-5''), Okuno, Journ. Jap. Bot., 27: 48, pl. 1, figs. 6-6''', & 27: 347, pl. 1, figs. 2'-2'' (1952).

Here in addition to the previous papers above mentioned, I will report on the structure of the joint between the long spine and the valve, and also on the structure of the short, clawed spine. The joint between the valve and the long spine is a modified enarthrosis (fig. 5'). The semiglobular base of the spine is perhaps hanging on the horizontal processes of the socket (or on the contrary, the horizontal processes of the spine are inserted in the socket?). The bottom-membrane of the socket is porous with roundish holes arranged in longitudinal rows. Holes roundish, about 80 m μ in diameter and about 10-11 in 1 μ . The clawed spine is club-shaped, armed with a U-shaped claw at the end. The claw is strongly silicate, denticulate at the inner margin. The denticles of the claw about 37 m μ long, and about 8-10 in 10 μ (cf. Kolbe, Ark. f. Bot., 33, A. no. 17: 13, pl. 6, fig. 11).

(3) The pore of the diatom frustules or spines, which is not locular, and opened free or closed with a sieve membrane. This is to be understood in contrast with the locular pore, the 'loculus.' In my previous papers, the hole was described as the 'simple pore.'

Supplement

In my papers nos. 1-5, I have described in details the fine structure of the frustules of 24 kinds of antarctic diatoms, including 11 genera, 18 species, 2 varieties, 2 forms and 3 doubtful species. But the number of these species is less than the half of the total number of the species found in the present antarctic collection. Of the other species, I could not yet research them in the electron microscope, partly because of their rare occurrence and partly because of the difficulty of preparing them for the electron microscopy. Among them, the noticeable species will be noted in the following.

Chaetoceros bulbosum (Ehrenberg) Heiden (Pl. III, figs, 1a-c), Heiden & Kolbe, Mar. Diat. Deut. Südpol.-Exped.: 526, pl. 9, fig. 171 (1928); Mills, Index Diat.: 375 (1933).

Syn. *Chaet. radicum* Castracane, Rep. Voy. Challenger, Bot., 2: 79 (1886); Karsten, Phytopl. Antarkt. Meer.: 117, pl. 15, figs. 3, 3a (1905).

Cells solitary or in chains (in the present collection, always found solitary). Valves elliptic, somewhat concave in the centre, about 25-45 μ in major axis. At the centre of the valve, with a small seta, and near the apical ends of the valve, with two short, bulbous spines. Spines about 20-35 μ long, about 7-12 μ in diameter, in many cells almost vertical (fig. 1a), rarely horizontal (fig. 1b), with many longitudinal furrows, extending to near the end. The end of the spine pointed with a narrow canal communicating to the basal, bulbous cavity of the spine.

According to Karsten, when the cells connected in chains, only the terminal spines of the end cells are short and bulbous, and all the others are longer and slender (Karsten, l. c., fig. 3a).

Endemic to the Antarctic Ocean; very rare. Sample: no. 40 (+); no. 43 (+).

var. **Schimperana** (Karsten) Heiden (Pl. III, fig. 2), Heiden & Kolbe, Mar. Diat. Deut. Südpol.-Exped.: 528, pl. 10, fig. 174, pl. 11, fig. 176 (1928); Mills, Index Diat.: 375 (1933).

Syn. *Chaet. Schimperianum* Karsten, Phytopl. Antarkt. Meer.: 117, pl. 15, figs. 2, 2a, b, pl. 16, fig. 4 (1905).

Cells solitary or in chains (in the present collection, always found solitary). The valve elliptic, 13-40 μ in major axis, in the centre with a small

seta. Spines horizontal, conspicuously longer than those of *Chaet. bulbosum* var. *bulbosum*, about 60-160 μ in length, tapering from the bulbous base to the slender, hair-like end.

Endemic to the Antarctic Ocean. Sample: no. 20 (+); no. 25 (+); no. 34 (+); no. 43 (++) ; no. 60 (++) ; no. 108 (+).

Charcotia bifrons (Castracane) M. Peragallo (Pl. I, figs. 7a-b; Pl. III, fig. 3), 2me Antarct. Exped. Franc.: 78 (1921); Mills, Index Diat.: 402 (1933).

Syn. *Coscinodiscus bifrons* Castracane, Rep. Voy. Challenger, Bot., 2: 156, pl. 2, fig. 1 (1886).

This fine species was discovered by Castracane, examining a preparation made near the ice-barrier of the Antarctic on 24th February 1874. According to him, the upper and the lower valves are different in their ornamentation, and he owing to such dimorphism of the valves, put this species provisionally in *Coscinodiscus*. In 1921, M. Peragallo published a new genus 'Charcotia' and transferred this species to the new genus. The characteristics of the valve I found in my slide (no. m 662) are as follow: Diameter about 78 μ . The radiating rows of the frustule pores are longer and shorter, which disappear at a distance from the margin of the valve. Frustule pores subrectangular, about 12 in 10 μ . Central area with a rosette consisted of several polygonal frustule pores. The rosette surrounded by an annular hyaline space. Marginal zone is finely striated, striae about 20-24 in 10 μ . A submarginal, annular hyaline space is seen between the radiating rows of frustule pores and the marginal zone. In the present specimen, the extraordinarily delicate radiating striae at the bottom of the valve were invisible (cf. Castracane, l. c.!). *Cosc. bifrons* Castracane (Karsten, Phytopl. Antarkt. Meer.: 79, pl. 4, fig. 3. in which the central rosette is absent) is probably a synonym or a variety of this species.

Endemic to the Antarctic Ocean; very rare. Sample: no. 60 (+).

Schimperiella antarctica Karsten (Pl. III, figs. 4a-b), Phytopl. Antarkt. Meer.: 88, pl. 8, figs. 6a, b (1905); Mills, Index Diat.: 1428 (1934).

Diameter about 40-46 μ . Valves dimorphic. The valve is somewhat convex, with a broad, flat marginal zone. Surface of the valve with round frustule pores arranged in more or less radiating rows. Frustule pores 6-8 in 10 μ , larger in the middle, smaller and denser near the marginal zone,

where they are arranged in tangential secondary rows concave towards the outside. Marginal zone about $5\ \mu$ broad, finely striated, striae 10-13 in $10\ \mu$. In my slides, I could not find the valve b. According to Karsten, the valve b is as follow: "Schale b zeichnet sich durch ein sehr feine System radialer Punktlinien mit keilförmiger Anordnung aus und wird nahe dem Rande von einer Linie sehr grober, ein wenig tangential ausgezogener Punkte umgrenzt."

Fig. 4a. Painted on the surface of the valve. Fig. 4b. Painted on the marginal zone.

Endemic to the Antarctic Ocean. Sample: no. 8 (+), no. 12 (+++); no. 15 (+); no. 20 (+); no. 29 (+); no. 34 (+++); no. 60 (+); no. 82 (+); no. 90 (++) ; 91 (+); no. 99 (+); no. 111 (+); no. 116 (+).

var. **minutula** Okuno, var. nov. (Pl. I, fig. 3; Pl. III, fig. 5)

Valvae circulares, zona media leviter convexa, diametro ca. $20\ \mu$. Zona media grosse areolata, areolis 10-15 in $10\ \mu$, in seriebus radiantibus positis. In zonam submarginale, series areolarum radiales et tangentiales notatae. Zona marginalis ca. $2\ \mu$ lata, cum spinulis ca. 3-4 in $10\ \mu$, delicate striata, striis radiantibus, ca. 15 in $10\ \mu$.

Valves circular, slightly convex, ca. $20\ \mu$ in diameter. Areolae in radiating rows, 10-15 in $10\ \mu$, decreasing their diameter from the centre to the border of the valve, where areolae arranged in tangential secondary rows concave towards the outside. At the border of the valve, with small spines about 3-4 μ in $10\ \mu$. Marginal zone narrow, about $2\ \mu$ broad, striae about 15 in $10\ \mu$.

The present variety differs from *Schim. antarctica* var. *antarctica* by its smaller diameter, narrower marginal zone, and by the presence of small spines on the border of the valve a. And, differs from *Schim. Valdiviae* Karsten (Karsten, Phytopl. Antark. Meer.: 88, pl. 8, figs. 7a, b. 1905) by the ornamentation of the valve and the presence of small spines on the border of the valve a. The valve b is not yet found.

Sample: no. 15 (+).

Cocconeis scutellum Ehrenberg var. ? (Pl. III, fig. 6)

The upper valve with narrow-linear pseudoraphe. About $50\ \mu$ long, about $35\ \mu$ broad. Striae radiate, 7-9 in $10\ \mu$, finely punctate, puncta about 10-11 in $10\ \mu$. Marginal zone broad, striated, striae about 7 in $10\ \mu$. The lower valve could not be found in my slides.

This doubtful form is finer in its striae and punctuation of the upper valve than *Cocc. scutellum*. The fine striae and punctuation are rather near to those of the lower valve of *Cocc. scutellum*.

Sample: no. 62 (+).

Fragilaria cylindrus Grunow (Pl. I, fig. 4), Hustedt, Kieselalg., 2: 152, fig. 665; Mills, Index Diat.: 730 (1934).

Valves linear, with rounded ends. About 22-24 (6-40) μ long, about 3-4 (2-5) μ broad. Transverse costae robust, not interrupted, about 13-15 (13-22) in 10 μ .

Rare; Sample: no. 9 (+).

Navicula Trompii Cleve? (Pl. I, figs. 5a-b)

Valves lanceolate, with acute ends. About 100 μ long, and about 12 μ broad. Raphe straight. Central and axial areas very narrow. Transverse striae very fine, parallel, about 28-30 in 10 μ crossed by longitudinal, parallel lines, about 18 in 10 μ .

This doubtful form is near *Nav. Trompii* var. *major* (Heiden & Kolbe, Mar. Diat. Deut. Südpol.-Exped.: 625, pl. 3, fig. 77. 1928), but the valve is smaller than that of the variety. I found the name *Nav. Trompii* Cleve in Mills, Index Diat.: 1172 (1934), but I could not refer to the original description of the species in Cleve, Plank. South. Atlant. & South. Ind. Ocean (1900).

Very rare; Sample: no. 27 (+).

Nitzschia antarctica Okuno, sp. nov. (Pl. III, fig. 7).

Valvis late ellipticis, cum poris subrostratis. Ca. 12-26 μ longis, ca. 10-20 μ latis. Carina valde excentrica, punctis carinalibus 10-11 in 10 μ . Costae transversae non interruptae, ca. 10-11 in 10 μ . Fasciae longitudinales obliteratae.

This new species is very near to *Nitzschia tryblionella* Hantzsch var. *debilis* (Arnott) A. Mayer. But differs from it by the following: 1) Keel not constricted in the middle. 2) The two median keel puncta are equally distant as the others. 3) Keel puncta are same in number and in structure to the striae of the valve. 4) Transverse striae denser. 5) Longitudinal fasciae on the valve absent.

Sample: no. 8 (+); no. 111 (+).

Tropidoneis antarctica (Grunow) Cleve (Pl. I, figs. 6a-b; Pl. III, fig.

8), Synop. Nav. Diat., 1: 24 (1894); Karsten, Phytopl. Antarkt. Meer.: 128, pl. 18, fig. 7 (1905); Mills, Index Diat.: 1672 (1934); Boden, Journ. Mar. Res., 8, No. 1: 8 (1949).

Syn. *Stauroneis glacialis* Castracane, Rep. Voy. Challenger, Bot., 2: 24, pl. 27, fig. 11 (1886). — *Amphiprora fragilis* Brun & Tempère, Diat. Foss. Jap.: 14, pl. 9, fig. 14 (1889).

Valves membranaceous, elliptic, with subacute ends. About 200-250 (48-250) μ long, and about 50-60 μ broad in the girdle view. Valves convex longitudinally and transversely, and slightly concave in the central area. Central area with two short costae bilaterally. Transverse striae very fine, parallel, about 13-20 (13-21) in 10 μ , finely punctate, puncta about 16-17 in 10 μ . Girdle view elongated, with biarcuate margins, and sometimes slightly rostrated at the ends.

Sample: no. 4 (+); no. 9 (+); 40 (++); no. 43 (+); no. 60 (+).

Literature cited

(An addition to Journ. Jap. Bot., 27: 51)

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Clevé-Euler, A.: 1951. Die Diatomeen von Schweden und Finland.,

Kungl. Sv. Vet.-Akad. Handl., 2, No. 1.

○ミヤマイクビゴケ北海道に産す (佐々木太一) Taichi SASAKI: *Diphyscium foliosum* Mohr. found in Hokkaido.

現在日本産イクビゴケ属 (*Diphyscium*) としてはイクビゴケ, ヒメイクビゴケ, ミヤマイクビゴケ, コバノイクビゴケの4種が報告されている〔高木典雄, 植研 25: 8〕。このうちのヒメイクビゴケは辻部正信氏が大雪山より記載したもので本道には本種以外には報告がない。筆者は昨夏石狩国安足間 (アンタロマ) で本属の藻を若干見出し, 野口彰博士の検定によりミヤマイクビゴケ (*D. foliosum* Mohr.) であることが判明した。本種は高木氏により初めて本州中部の山岳地帯から報告されたが, 氏の記される如く一見イクビゴケ (チャイロイクビゴケ) によく似ている。筆者が見出したのは標高約300mの石狩川岸の岩上の砂質土である。尙この附近にはウチワチョウジゴケも数個体見出された。終りに本種の検定を賜つた野口彰博士に感謝の意を表する。

(北海道上川郡愛別村立愛山中学校)

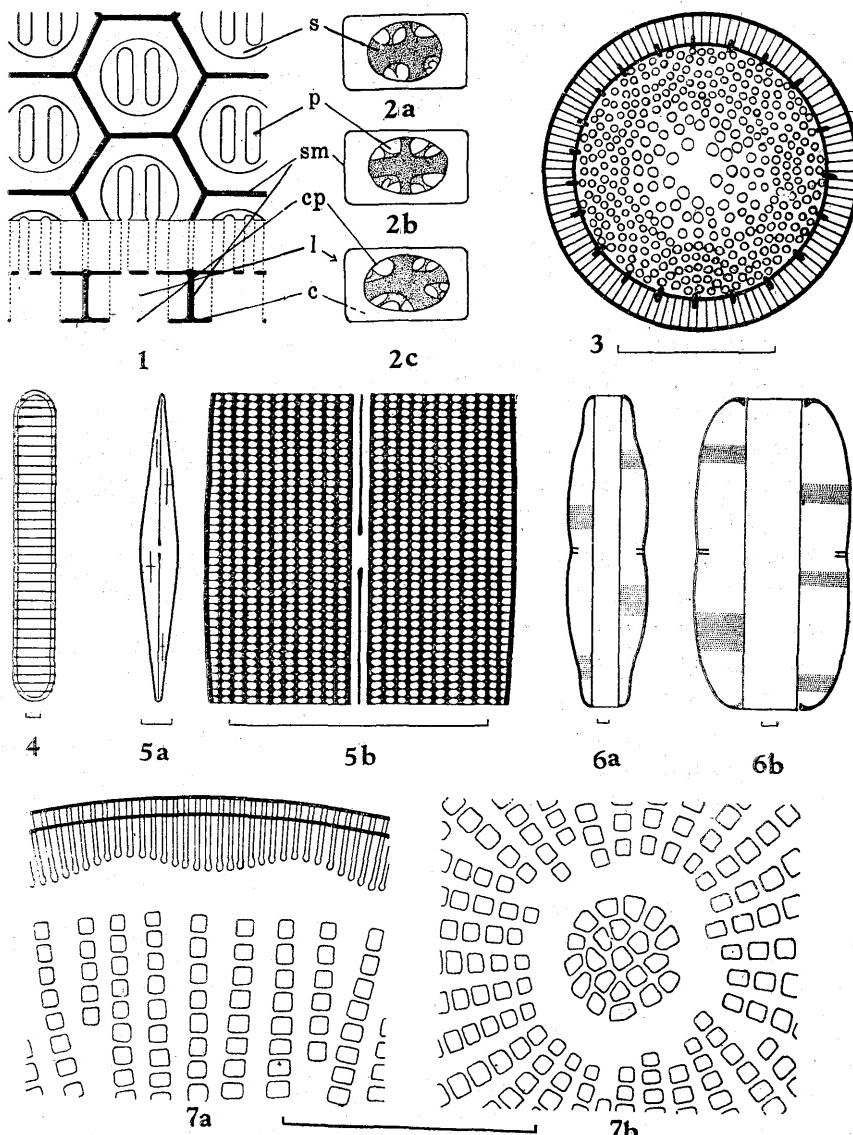


Fig. 1, Loculi of *Rhizosolenia hebetata* f. *semispina*. 2a-c, Loculi of *Cicconeis costata*. 3, *Schimperella antarctica* var. *minutula*. 4, *Fragilaria cylindrus*. 5a-b, *Navicula Trompii*? 6a-b, *Tropidoneis antarctica*. 7a-b, *Charcotia bifrons*. 7a, Margin of the valve. 7b, Centre of the valve. (c, Cover membrane. cp, Cover pore. 1, Loculus. p, Sieve pore s, Sieve membrane. sm, Side membrane. Scales: 10 μ).

H. Okuno: Antarctic Diatoms

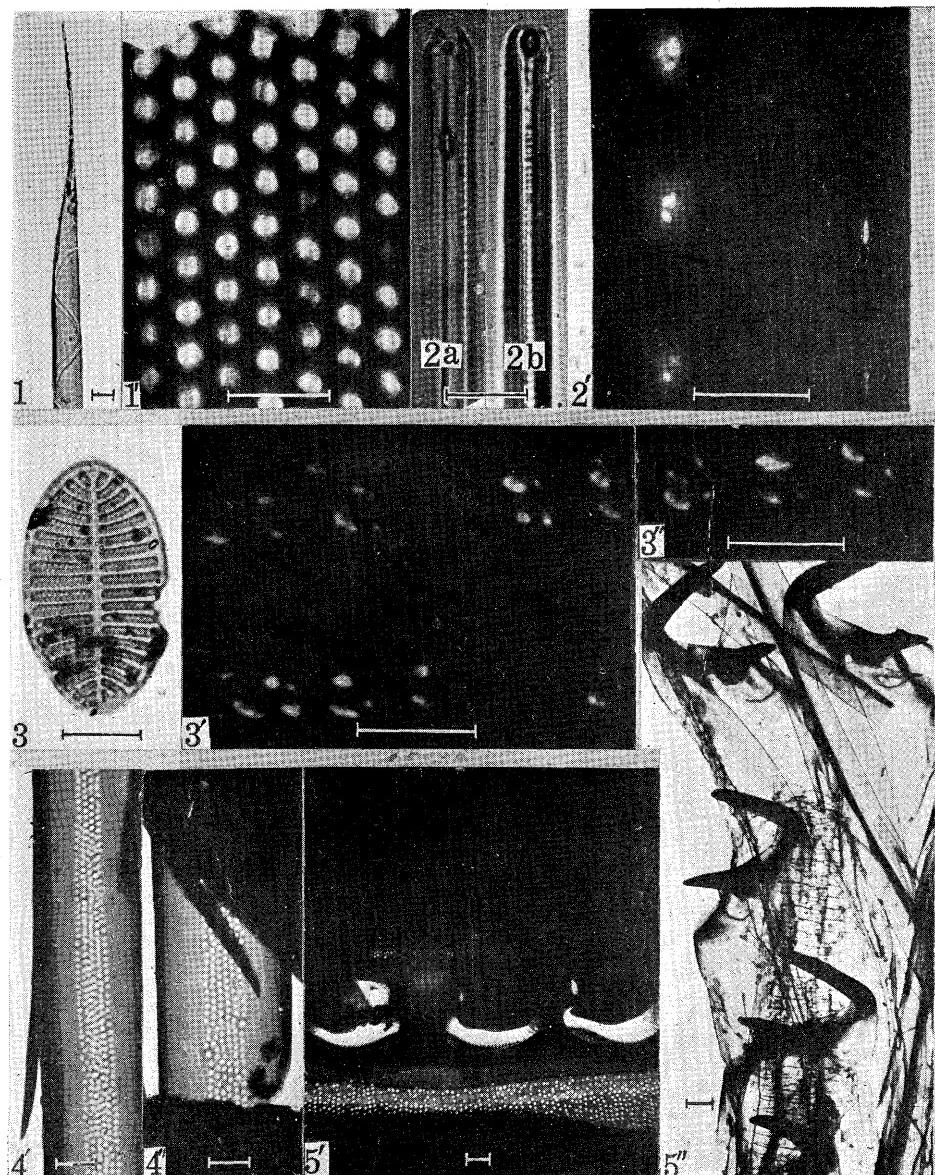


Fig. 1-1', *Rhizosolenia hebetata* f. *semispina*. 2a-2', *Thalassiothrix longissima*. 3-3'', *Cocconeis costata*. 4-4'', Spines of *Chaetoceros eriophilum*. 5'-5'', *Corethron Valdiviae*. (5', A portion of the frustule, showing the joints. 5'', Clawed spines.) 1, 2a-b, 3, Light micrographs. Scales: 10 μ . 1'-5'', Electron micrographs. Scales: 1 μ .

H. Okuno: Antarctic Diatoms

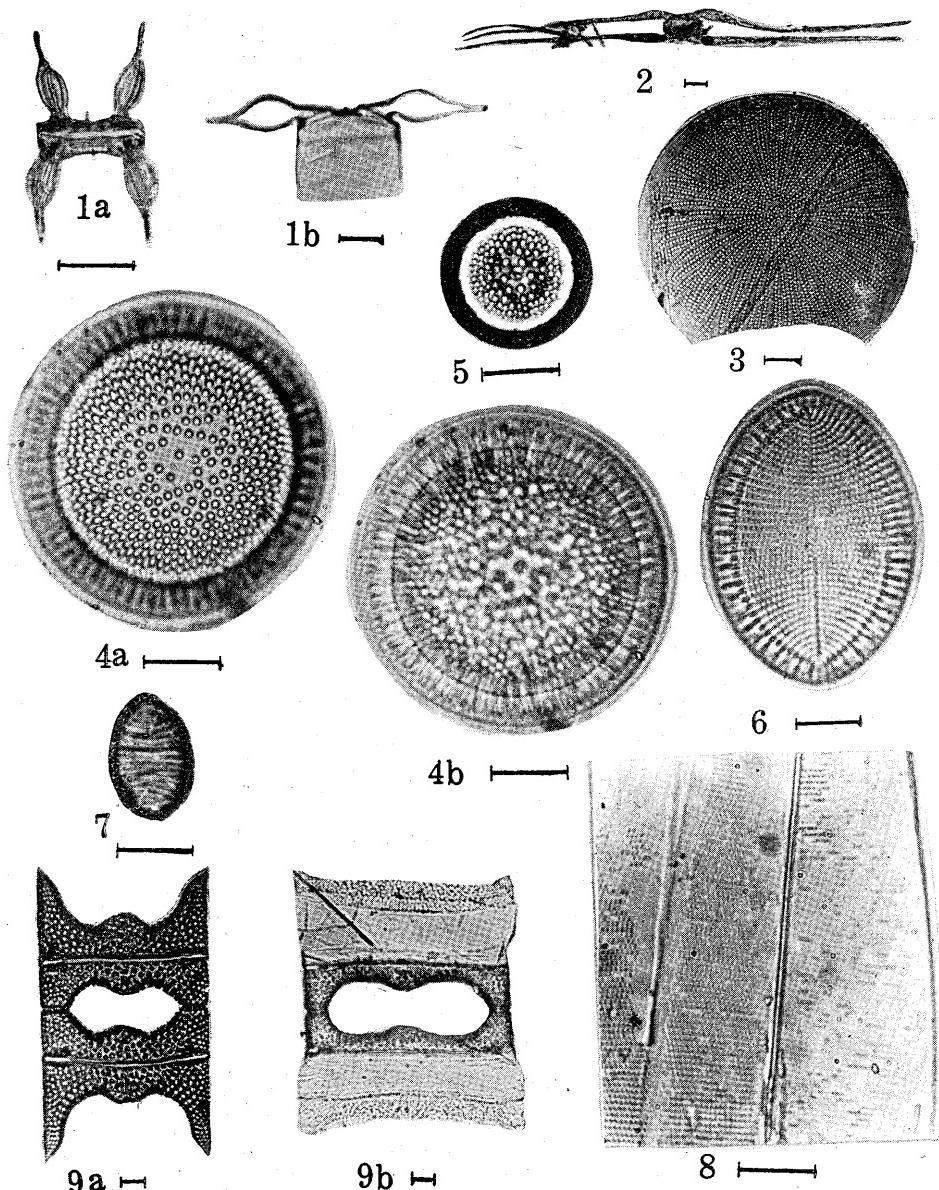


Fig. 1a-b, *Chaetoceros bulbosum*. 2, var. *Schimperiana*. 3, *Charcotia bifrons*. 4a-b, *Schimperiella antarctica*. 5, var. *minutula*. 6, *Cocconeis scutellum* var.? 7, *Nitzsch'a antarctica*. 8, *Tropidoneis antarctica*. 9a-b, *Eucampia balaustium* (showing the different stages of growth; cf. Okuno, Journ. Jap. Bot., 27: 350). 1a-9b, Light micrographs. Scales: 10 μ .

H. Okuno: Antarctic Diatoms